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Combined caudal-superficial-epigastric axial pattern flap and full-thickness buccal mucosa graft for single-stage preputial reconstruction in six dogs

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Abstract: **OBJECTIVE:** To describe the use of a caudal superficial epigastric flap in combination with a full-thickness oral mucosal/submucosal graft for single-stage reconstruction of extensive preputial defects in dogs. **MATERIALS AND METHODS:** Medical records of dogs with extensive preputial defects either of traumatic origin or derived from tumour excision were reviewed. In all dogs, the prepuce was reconstructed using a full-thickness oral mucosal/submucosal graft combined with a caudal superficial epigastric axial pattern flap during a single surgical procedure. Outcome was assessed by routine clinical examinations for 6 months postoperatively, and through telephone follow-up thereafter. **RESULTS:** Six dogs were included. The caudal superficial epigastric axial pattern flap healed without complications in all dogs, while the full-thickness oral mucosal/submucosal graft failed in one dog. In this individual the skin flap underwent contracture 30 days after surgery and preputial advancement was required. One dog showed postoperative discomfort during urination, which was successfully managed with a Foley catheter and analgesic administration. Three dogs developed paraphimosis at 30, 80 and 90 days, respectively, and required further surgery. Long-term results were good in all dogs. **CLINICAL SIGNIFICANCE:** The use of a full-thickness oral mucosal/submucosal graft combined with a caudal superficial epigastric axial pattern flap is feasible for single-stage preputial reconstruction in dogs. Attention should be paid to create a sufficiently large preputial opening, in order to prevent paraphimosis.

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1 **COMBINED CAUDAL-SUPERFICIAL-EPIGASTRIC AXIAL PATTERN FLAP AND**
2 **FULL-THICKNESS BUCCAL MUCOSA GRAFT FOR SINGLE STAGE PREPUTIAL**
3 **RECONSTRUCTION IN SIX DOGS**
4

5 **Objective:** To describe the use of a caudal superficial epigastric flap in combination with a full-
6 thickness oral mucosal/submucosal graft for single stage reconstruction of extensive preputial
7 defects in dogs.

8 **Methods:** Medical records of dogs with extensive preputial defects either of traumatic origin or
9 derived from tumour excision were reviewed. In all dogs, the prepuce was reconstructed using a
10 full-thickness oral mucosal/submucosal graft combined with a caudal superficial epigastric axial
11 pattern flap during a single surgical procedure. Outcome was assessed via routine clinical
12 examinations for six months postoperatively, and by telephone follow-up thereafter.

13 **Results:** Six dogs were included. The caudal superficial epigastric axial pattern flap healed without
14 complications in all dogs, while the full-thickness oral mucosal/submucosal graft failed in one dog.
15 Contraction of the skin flap occurred in the latter dog 30 days after surgery, and required a preputial
16 advancement. One dog showed postoperative discomfort during urination, which was successfully
17 managed with a Foley catheter and analgesics administration. Three dogs developed paraphimosis
18 at 30, 80 and 90 days, respectively, and required further surgery. Long-term results were good in all
19 dogs.

20 **Clinical significance:** The use of a full-thickness oral mucosal/submucosal graft combined with a
21 caudal superficial epigastric axial pattern flap is feasible for single stage preputial reconstruction in
22 dogs. Attention should be paid to create a sufficiently large preputial opening, in order to prevent
23 paraphimosis.

27

28 **Introduction**

29

30 Canine prepuce is a complex structure composed by parietal layers continuous with the skin of the
31 ventral abdomen and a visceral layer, which covers and moistens the penis. A cosmetic and
32 functional preputial reconstruction may thus be difficult to achieve. To date, little attention has been
33 given to such issue in the veterinary literature (Smith & Gourley 1990). The presence of extensive
34 preputial defects ~~determines~~may result in chronic penile protrusion, which ~~results in~~lead to
35 desiccation and inflammation of the penile surface, leading to self-trauma, balanoposthitis (Boothe
36 2003), and consequent ulceration, haemorrhage or even partial penile necrosis. Some dogs may
37 show discomfort during urination due to penile and urethral inflammation (Olsen & Salwei 2001,
38 Papazoglo 2001, Boothe 2003, Galanty et al. 2008, Grossman & Baltzer 2012). Medical
39 management of this condition is aimed at decreasing inflammation and providing a moist preputial
40 environment to protect the penis; unfortunately, long-term owner compliance is often poor and
41 surgical intervention may become necessary. In case of extensive preputial tissue loss or resection,
42 for instance after *en bloc* removal of tumours, partial or complete penile amputation with or without
43 scrotal urethrostomy is often required (Papazoglo 2001, Boothe 2003, Galanty et al. 2008, Boothe
44 2012). A three stage surgical procedure for preputial reconstruction that involves implantation of a
45 mucosal surface near the penis has been described, but such procedure was considered demanding
46 and expensive (Smith & Gourley 1990).

47 To the best of our knowledge, a single stage surgical procedure for the reconstruction of extensive
48 preputial defects in dogs has not been reported yet. The aim of this paper is to describe and assess
49 the results of a single stage surgical technique for preputial reconstruction in six dogs, following
50 extensive traumatic tissue loss or wide tumour resection; the surgical procedure that we report
51 consists of a caudal superficial epigastric axial pattern flap combined with a full-thickness oral
52 mucosal/submucosal graft.

53

54 **Materials and Methods**

55

56 Medical records of dogs that underwent preputial reconstruction using a caudal superficial
57 epigastric axial pattern flap transposition combined with a full-thickness oral mucosal/submucosal
58 graft following extensive tissue loss caused by tumour removal or trauma were reviewed.
59 Information collected included sex, breed, age and weight of the dogs, presenting complaints,
60 dimension of the preputial defect as assessed by the surgeon, and preoperative diagnostic work-up.
61 Preoperative evaluation included physical examination, complete blood count, serum biochemical
62 profile, and cytology of the preputial mass (in case of suspected tumour); if cytology was highly
63 suggestive of tumour, clinical staging was performed and consisted of thoracic radiographs (3
64 orthogonal projections), abdominal ultrasonography, and cytology of the inguinal lymph nodes. The
65 latter were also removed at the time of primary tumour excision and submitted for histopathological
66 evaluation. No attempt was made to identify further draining lymph nodes other than the inguinal
67 nodes. Surgical data and follow-up information retrieved from medical records included technical
68 details of the procedures and short- and long-term complications (defined as within and after 30
69 days postoperatively, respectively). Histological examination of the excised preputial tumours also
70 included evaluation of resection margins. Surgical margins were classified as free from residual
71 tumour (R0, ≥ 1 mm), no residual tumour but minimal distance between tumour and resection
72 margin (R1, ≤ 1 mm), microscopic residual tumour at the resection margins (R1-dirt), and local
73 macroscopic residual tumour (R2) (Wittekind et al. 2009).

74 Postoperative complications were defined as minor when they were managed conservatively and
75 major when further surgery was required. Functional and cosmetic outcome were subjectively
76 evaluated and classified as good, acceptable or poor based on clinician and owner assessment
77 (Table 1).

78 *Surgical procedure*

79 In all dogs, anaesthesia was induced with IV injection of fentanyl (2 µg/kg) and propofol (4 mg/kg)
80 and maintained with isoflurane in oxygen at 0.5 litre per minute. All dogs received cephazolin (22
81 mg/kg, IV) at the time of induction. Anaesthetised dogs were positioned in dorsal recumbency, and
82 both the ventral abdomen and the oral cavity were aseptically prepared for surgery. Chlorhexidine
83 2% and alcohol combination and sterile saline were used for preparation of the skin and oral cavity,
84 respectively. The apex and variable portions of the prepuce were reconstructed in five dogs, whilst
85 in one dog (no. 3) the defect was located centrally (Fig. 2). In case of tumour excision, surgical
86 gloves and instruments were changed prior to preputial reconstruction. The exposed penis and the
87 subcutaneous tissues were protected with saline-soaked gauze sponges during surgery. For the full-
88 thickness oral mucosa grafts harvesting, both mucosa and submucosa of the lip and/or cheek were
89 incised with a no. 10 scalpel blade and elevated submucosally using skin hooks or Adson-Brown
90 tissue forceps, and Metzenbaum scissors (Fig. 1-B). The free grafts were collected from the lip
91 and/or cheek on the surgeon's side; no specific anatomic landmark was considered for graft
92 harvesting and its size was decided based on the dimensions of the preputial defect. Major bleeding
93 was managed with vessel ligation, while minor haemorrhage was controlled using electrosurgery.
94 The resulting oral defect was left to heal by second intention. In dog no. 3, the preputial defect was
95 located at the body of the penis and a smaller oral graft was required, as the dorsal part of the
96 preputial mucosa had been preserved during tumour excision (Fig. 2). In dog no. 6, the harvested
97 oral graft was meshed in order to completely cover the preputial defect (Fig. 3). In the remaining
98 cases, the mucosal graft fitted well into the receiving site. In order to obtain grafts consisting of
99 mucosa and submucosa only, both fat and residual muscle tissue were removed before graft
100 placement. The mucosal graft was then apposed circumferentially around the penis (with the
101 mucosal surface facing the penis) and sutured to the residual preputial mucosa with absorbable
102 monofilament sutures (4-0 Monocryl) in a continuous pattern (Fig 1-C). The caudal superficial
103 epigastric axial pattern flap was then created preserving the subcutaneous fat, elevated, and rotated

104 to reach the preputial defect. The transposition angles ranged from 50° to 90°, depending on which
105 part of the prepuce was involved. No suture was applied between the graft and the deep surface of
106 the caudal superficial epigastric axial pattern flap, in order to avoid accidental damage of the caudal
107 superficial epigastric artery. The deep aspect of the axial pattern flap was then sutured to the
108 submucosal surface of the oral graft. The preputial orifice was created by suturing the apex of the
109 axial pattern flap to the underlying mucosal surface of the oral graft; the diameter of the
110 reconstructed preputial opening was subjectively decided by the surgeon. After placing a Redon
111 active suction drain (Emodren® - Medicalplastic s.r.l.), the lateral borders of the caudal superficial
112 epigastric axial pattern flap were sutured to the receiving site in two layers with an appositional
113 continuous pattern (Fig. 1-D and 1-E). The donor site was routinely closed.

114 An indwelling urethral catheter was not placed prior to anesthetic recovery in any of the six dogs.
115 All dogs were managed postoperatively with opioids (buprenorphine 20 µg/kg IV q 8 h at the end of
116 the procedure, progressively tapered and discontinued as the dogs recovered) and non-steroidal anti-
117 inflammatory drugs (meloxicam 0.2 mg/kg PO SID for the first day and 0.1 mg/kg SID for 4 days
118 thereafter) in order to control discomfort and reduce inflammation. Cephazolin (20 mg/kg SC BID)
119 was administered for 1-5 days postoperatively; for patients discharged earlier, Cefadroxil (20 mg/kg
120 PO SID) was administered at home till day 5.

121 General clinical condition, appetite and possible urinary discomfort were monitored postoperatively
122 for the first days. All patients were discharged after drain removal, which occurred when production
123 of fluid was less than 0.2 ml/kg/h (Shaver et al. 2014). Surgical wounds were evaluated daily during
124 hospitalization, and every 3-5 days after discharge until complete healing. The use of an
125 Elizabethan collar was suggested until skin suture removal. Dogs with histologically confirmed
126 malignant tumour were rechecked by the referring veterinarian (physical examination, chest
127 radiographs, abdominal ultrasound) every three months for the first year after surgery, and every 6
128 months during the second year.

130 **Results**

131

132 *Signalment, clinical findings and diagnosis*

133 Six male dogs (4 intact and 2 castrated) were included. Body weight ranged from 6 to 38 kg (mean
134 21 kg). (Table 2) Five dogs were referred because of a preputial neoplasm and one dog for a
135 traumatic preputial lesion. Cytology of inguinal lymph nodes did not reveal tumour cells in any of
136 the 5 dogs with a malignant tumour. Histologically, tumour types included: primary cutaneous mast
137 cell tumour (cMCT; Patnaik grade II, Kiupel low grade) in two dogs; recurrence of a cMCT
138 (Patnaik grade II, Kiupel low grade) in one dog; primary squamous cell carcinoma in one dog; and
139 second recurrence of a grade I soft-tissue sarcoma in one dog (Kuntz 1997). Maximum tumour
140 diameter ranged from 2 to 3 cm (Table 2). All surgical margins were classified as R0, as
141 histological evaluation excluded the presence of residual tumour cells. Histological examination of
142 the inguinal lymph nodes confirmed the absence of metastatic disease. Dog no. 6 had an extensive
143 traumatic lesion involving most of the prepuce (including the apex) caused by a bite six months
144 before presentation.

145

146 *Surgical procedure*

147 Preputial tumours were surgically removed with a peripheral margin of at least 2 cm; deeply, full
148 thickness resection reached the preputial cavity (Fig. 1-A). Bilateral superficial inguinal
149 lymphadenectomy was performed; to complete clinical staging, all nodes were submitted for
150 histological evaluation, even if pre-operative cytological examination had shown no signs of nodal
151 metastasis. The dog with a defect of traumatic origin (no. 6) underwent excision of the whole scar
152 tissue. The preputial defects ranged in size from 4x5 cm to 10x7 cm (Table 2). The caudal
153 epigastric axial pattern flap was created on the right side in three dogs and on the left side in the

154 remaining three. In dogs with paramedian tumour localisation, the axial pattern flap was elevated
155 from the contralateral side. In all six dogs, only the last two mammary glands were elevated to
156 create the axial pattern flap. All surgeries were performed in less than 90 minutes (range 65-88
157 minutes; mean 80 minutes). The active suction drain was kept in place for one to four days
158 postoperatively (mean 2 days). All dogs wore an Elizabethan collar during hospitalisation.

159

160 *Outcome*

161 During hospitalisation, dog no. 1 showed stranguria and pollakiuria and attempted to lick the
162 genitalia during urination. A decision was made to place a Foley catheter, which was kept for 48
163 hours till urination became normal. All other dogs had physiological urination, and were discharged
164 two to four days postoperatively, after drain removal.

165 All the axial pattern flaps healed uneventfully, with no visible sign of necrosis at clinical
166 examination (Fig. 1-F). In dog no. 4, the full-thickness oral graft appeared to have completely failed
167 at day 5. This dog showed dysuria and licking of the prepuce; the graft was removed on day 6 under
168 mild sedation by gentle and minimal traction. After graft removal, signs of discomfort resolved and
169 the resulting preputial defect was left to heal by second intention. Unfortunately, contraction of the
170 skin flap resulted in paraphimosis at day 30 (Fig. 4). Surgical enlargement of the preputial orifice
171 combined with a preputial advancement was performed. Firstly, the preputial orifice was incised
172 ventrally in a craniocaudal direction, and a small wedge was removed from the very cranial part of
173 the opening. A larger orifice was obtained by suturing the mucosa to the skin margins of the wedge
174 (Wilson 1975). The preputial muscles were folded and then sutured over themselves thus obtaining
175 an adequate preputial advancement. Final functional and cosmetic outcome in this dog were
176 considered good.

177 Two dogs developed paraphimosis at 80 (no. 6) and 90 days (no. 3) postoperatively, and required
178 surgical enlargement of the preputial orifice (as previously described); in both patients, good
179 cosmetic and long-term functional outcome were eventually obtained. The skin flap did not contract

180 in these two dogs. Urination was assessed as normal in all the dogs from the 3rd day after surgery.
181 The oral mucosa healed completely in 7 to 10 days postoperatively, and no dog showed difficulty
182 when eating or drinking. All dogs had transient contraction of the lip/cheek, which solved
183 spontaneously during the healing process, as confirmed by long-term follow-up examinations.
184 Dog no. 2 developed moderate inflammation of the preputial opening three months postoperatively
185 due to hair growth into the prepuce. This complication was probably caused by a mild contraction
186 of the oral graft during the healing process, which resulted in the traction of part of the skin flap
187 inside the preputial opening and consequent hair growth inside the prepuce. In this case,
188 conservative treatment with periodic hair clipping was elected, and surgical revision was not
189 necessary. Final functional and cosmetic outcome were considered acceptable.
190 Long-term follow-up information was obtained via periodic telephone interviews with the referring
191 veterinarian and/or dogs' owners. Minimum follow-up period was 400 days. At the time of writing,
192 all dogs were in good health and had no signs of local and/or distant tumour recurrence and/or
193 urinary problems. Long term cosmetic and functional outcome were considered satisfactory in all
194 cases by owners and surgeons.

195

196 **Discussion**

197

198 Extensive preputial defects currently represent a reconstructive challenge, as good cosmetic and
199 functional outcome are difficult to achieve (Smith & Gourley 1990, Boothe 2003, Fossum 2013).
200 Minor defects can be managed with local flaps, bipedicle flaps or preputial advancement combined
201 with preputial muscle shortening (Galanty et al. 2008, Papazoglo 2001, Olsen & Salwei 2001).
202 However, these techniques are less well suited to significant defects of the prepuce, and penile
203 amputation combined with castration and scrotal urethrostomy is often required (Boothe 2003,
204 Galanty et al. 2008, Papazoglo 2001, Boothe 2012).

205 A three-stage reconstructive technique for extensive preputial defects has been previously reported.
206 The technique involves use of a free mucosal oral graft combined with delayed transposition of a
207 vascularised flap (Smith & Gourley 1990). In that report, the oral graft was firstly sutured to the
208 subcuticular surface of a parapreputial skin flap vascularised by the caudal superficial epigastric
209 artery. The flap was then sutured back to the donor site; six weeks later, the flap/graft was isolated
210 and transposed to cover the penis in a two stage surgical procedure. The oral mucosa, composed of
211 stratified squamous epithelium, provided a suitable covering for the penis (Smith & Gourley 1990).
212 However, ~~such~~this technique was technically demanding and complete healing took several weeks;
213 reported disadvantages included increased risk associated with multiple surgical procedures and
214 difficulties in flap development, transfer and reconstruction (Smith & Gourley 1990).
215 To overcome such concerns, we decided to adopt a single stage surgical procedure. Dogs' owners
216 were informed of conventional treatment options, consisting of penile amputation combined with a
217 scrotal urethrostomy, but opted for the one-step procedure due to perceived invasiveness of penile
218 amputation. The caudal superficial epigastric axial pattern flap technique has been ~~largely~~widely
219 employed in veterinary reconstructive surgery, and has shown promising results (Lewin & Smith
220 2010, Aper & Smeak 2005, Mayhew & Holt 2003). The caudal superficial epigastric artery and
221 vein arise from the external pudendal artery and vein and ~~guarantee~~give an adequate vascular
222 supply to the flap. In the cases presented in this report, the flap was easily transposed over the apex
223 and/or body of the penis, and no patient showed healing complications or long-term discomfort.
224 Although development of caudal superficial epigastric axial pattern flap usually requires elevation
225 and transposition of the last three mammary glands in dogs (Evans & de Lahunta 2013), in the dogs
226 of this report elevation of the last two glands was sufficient to cover the preputial defects, thus
227 ~~guaranteeing~~giving adequate vascularisation of the whole transposed flap. In case of lateralised
228 neoplasms, the flap was created from the contralateral side of the tumour, in order to maintain
229 adequate vascular supply without compromising the resection margins.

Free oral mucosal/submucosal grafts have been previously used to augment the dorsal penile mucosa in combination with bilateral advancement flaps (Pope & Swaim 1986). The full-thickness mucosal/submucosal oral mucosa grafts used in the present study permitted to cover the exposed penis in a one-step procedure, and constituted a smooth interface. In five of the six dogs, the graft was outlined in order to surround the penis completely, and was sutured to the preputial mucosa. In the remaining dog (no. 6), the harvested graft was not large enough to cover the penis, and was thus meshed in order to augment its dimensions; this did not appear to interfere with correct healing. Granulation tissue growth into the meshed graft was not thoroughly evaluated since it would have required further anaesthesia; however, palpation of the surgical site two months postoperatively revealed a smooth and uniform interface between the penis and prepuce, and the dog did not show any abnormal clinical signs. Endoscopic examination of the prepuce of dog no. 3 during anaesthesia for an unrelated procedure showed good healing (Fig. 5). Conversely, the oral graft failed in dog no. 4; authors speculate that one important predisposing factor for failure in this dog was that he did not wear the Elizabethan collar consistently after discharge, thus allowing licking of the surgical site. Movement between the graft and the recipient bed has been identified as a cause of full-thickness skin grafts failure (Tong & Simpson 2012, Pope 1990); we thus suspect that graft movement and trauma caused by licking were major causes of graft failure in this case. Further causes of graft failure were not investigated as no other causative clinical conditions (such as local infection or seroma formation) were suspected. Thirty days after the first surgery, this dog underwent surgical revision of the preputial orifice combined with a preputial advancement, in order to completely cover the penis and solve paraphimosis. In this patient, penis exposure was caused by flap contraction during the healing process, which was probably due to mucosal graft failure and consequent lack of mucosal lining.

Paraphimosis also occurred in dogs nos. 3 and 6, and required surgical correction. Stenosis of the preputial orifice was only partial in these two dogs, and preputial lengthening was not required. It is reasonable to assume that lack of experience with this novel surgical procedure accounted, at least

256 in part, for these complications. In dogs no. 3 and 6, which were the first patients enrolled, the
257 reconstructed preputial orifice was too small. Therefore, a larger preputial opening was created in
258 the subsequent cases, in order to prevent postoperative paraphimosis; to reach this aim, it was
259 empirically considered that normal wound contraction would result in a 30-40% reduction in the
260 diameter of the reconstructed preputial orifice.

261 As the mucosal graft donor site was left to heal by secondary intention, all dogs experienced
262 transient lip/check contraction. Nonetheless, in all patients complete healing and re-epithelisation
263 occurred within ten days, no signs of discomfort were noted and cosmetic outcome was not
264 precluded.

265 Histologically, surgical margins of all excised tumours were clean, and no local recurrence occurred
266 in any dog, as confirmed by long-term follow-up examinations. The risk of incomplete tumour
267 excision was discussed with the owners before surgery, particularly for those dogs presenting with
268 tumour recurrence. In all dogs, preoperative tumour staging excluded macroscopic tumour spread,
269 which was subsequently confirmed by histological evaluation of the regional lymph nodes.
270 Alternative treatment options were offered to dogs' owners, and included: marginal excision and
271 primary closure followed by radiation therapy and/or systemic chemotherapy depending on tumour
272 grade and regional lymph nodes status; and a two-step procedure that involved tumour excision and
273 histological examination of surgical margins followed by a second reconstructive surgery.
274 However, all owners opted for the one-stage procedure, primarily for financial reasons, and
275 accepted the potential risk of incomplete tumour excision.

276 This report describes a novel one-stage surgical procedure for preputial reconstruction in dogs,
277 consisting of a full-thickness oral mucosal/submucosal graft combined with a caudal superficial
278 epigastric axial pattern flap. Although the reconstructive technique here reported was performed as
279 a single stage procedure, 50% of the dogs developed short-term complications, which required
280 further surgery. The high complication rate encountered in this case series raises the question
281 whether a single stage reconstruction of the prepuce may actually be superior to previously reported

techniques. Further studies are needed to assess results of preputial reconstruction with caudal superficial axial pattern flaps alone, without mucosal grafts. However, our clinical experience with this small series of dogs suggests that lack of mucosal lining may result in a more pronounced scar contraction and consequent paraphimosis. To prevent this complication, it may be advisable to create a larger preputial orifice (30-40% more than a normal preputial opening), in order to prevent stenosis due to tissue contraction during healing process. Despite the low number of dogs included in the present study, functional results and feasibility of the procedure reported suggest that combination of caudal superficial epigastric axial pattern flap and mucosal graft may be a valid alternative for preputial reconstruction in dogs following tumour excision or extensive traumatic preputial damage. Long-term outcome in all dogs that we treated encourages clinical use of this single stage reconstructive technique, when indicated.

References

- Aper, R. L., Smeak, D. D. (2005) Clinical evaluation of caudal superficial epigastric axial pattern flap reconstruction of skin defects in 10 dogs (1989-2001). *Journal of the American Animal Hospital Association* 3, 185-192
- Boothe, H. W. (2003) Penis, prepuce and scrotum. In: Textbook of Small Animal Surgery. 3rd ed. Ed D. H. Slatter. W. B., Saunders, Philadelphia p 1540
- Boothe, H. W. (2012) Penis and prepuce. In: Veterinary Surgery Small Animal. Eds K. M. Tobias, S. A. Johnston, Elsevier p 1917-1927
- Evans, H. E., de Lahunta, A. (2013) Urogenital system. In: Miller's Anatomy of the dog, 4th edn. Eds Evans, H. E., de Lahunta, A. p 398-401
- Fossum T. W. (2013) Surgery of the reproductive and genital system. In: Small Animal Surgery 4th edn. Ed Fossum, T. W., Elsevier, p 853-855

308 Galanty, M., Jurka, P., Zielińska, P. (2008) Surgical treatment of hypospadias. Techniques and
 309 results in six dogs. *Polish Journal of Veterinary Sciences* 11, 235-243

310 Grossman, J., Baltzer, W. (2012) Use of a preputial circumferential mucosal flap for hypospadias
 311 management in a Boston terrier *Journal of Small Animal Practice* 53, 292–296

312 Kiupel, M., Webster, J.D., Bailey, K.L., et al. (2011) Proposal of a 2-tier histologic grading system
 313 for canine cutaneous mast cell tumors to more accurately predict biological behaviour. *Veterinary*
 314 *Pathology* 48, 147-155

315 Kuntz CA, Dernell WS, Powers BE, et al. (1997) Prognostic factors for surgical treatment of soft-
 316 tissue sarcomas in dogs: 75 cases (1986-1996). *Journal of American Veterinary Medical*
 317 *Association* 211(9), 1147-1151

318 Lewin, G. A., Smith, J. H. (2010) Repair of a canine forelimb skin deficit by microvascular transfer
 319 of a caudal superficial epigastric flap. *Journal of Small Animal Practice* 51, 119-122

320 Mayhew, P. D., Holt, D. E. (2003) Simultaneous use of bilateral caudal superficial epigastric axial
 321 pattern flaps for wound closure in a dog. *Journal of Small Animal Practice* 44, 534-538

322 Olsen, D., Salwei, R. (2001) Surgical Correction of a Congenital Preputial and Penile Deformity in
 323 a Dog *Journal of the American Animal Hospital Association* 37, 187–192

324 Papazoglo, L. G. (2001) Idiopathic chronic penile protrusion in the dog: a report of six cases
 325 *Journal of Small Animal Practice* 42, 510-513

326 Patnaik, A.K., Ehler, W.J., MacEwen, E.G. (1984) Canine cutaneous mast cell tumor: morphologic
 327 grading and survival time in 83 dogs. *Veterinary Pathology* 21, 469-474

328 Pope, E. R., Swaim, S. F. (1986) Surgical reconstruction of a hypoplastic prepuce. *Journal of the*
 329 *American Animal Hospital Association* 22, 73-77

330 Pope, E. R. (1990) Mesh skin grafting. *Veterinary Clinic North American Small Animal Practice*
 331 20, 177-187

332 Smith, M. M., Gourley, I. M. (1990) Preputial reconstruction in a dog *Journal of the American*
 333 *Veterinary Medical Association* 196, 1493-1496

334 Shaver, S. L., Hunt, G. B., Kidd, S. W. (2014) Evaluation of fluid production and seroma formation
335 after placement of closed suction drains in clean subcutaneous surgical wounds of dogs: 77 cases
336 (2005–2012). *Journal of the American Veterinary Medicine Association* 245, 211–215
337 Tong, T., Simpson, D. J. (2012) Free skin grafts for immediate wound coverage following tumour
338 resection from the canine distal limb. *Journal of Small Animal Practice* 53, 520-525
339 Wilson GP (1975) Symposium on surgical techniques in small animal practice. Surgery of the male
340 reproductive tract. *Veterinary Clinic of North America* 5, 537-550
341 Wittekind C, Compton C, Quirke P et al (2009) A Uniform Residual Tumor (R) Classification:
342 integration of the R classification and the circumferential margin status. *Cancer* 115, 3483-3488